Course Syllabus

Course Information

PHYSICS 2422: HONORS PHYSICS II - ELECTROMAGNETISM AND WAVES

Section 001: August 20 – December 3, 2009
Classes: TR 4:00 pm – 5:45 pm in CBW 1.103

Contact Information

INSTRUCTOR: Dr. Yuri Gartstein					
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Office hours: TBA		Problem solving sessions: TBA			

Course Pre-requisites, Co-requisites, and/or Other Restrictions

Pre-requisites: PHYS2325/PHYS2421 and MATH2419, Co-requisites: MATH2451, PHYS2126/PHYS2127.
Students are advised to refresh and polish their calculus skills as well as to ensure fluency with vectors and vector algebra. Elements of multivariable and vector calculus are assumed to be discussed and understood as the course proceeds.

Goals and Student Learning Objectives/Outcomes

This is a general physics calculus-based course on basic notions of electricity, magnetism and electromagnetic waves. The course is a more "intense" version of PHYS2326 in terms of its pace, scope, difficulty of the problems and the calculus to be used. While the math is a natural and necessary ingredient, it is the physical content and concepts that are at the heart of the course. To a large extent, the physical content is covered in the corresponding chapters of well-known standard textbooks quoted below. Lecture materials and other recommended books should be helpful for topics beyond "standard" and where vector calculus is used. In teaching this course, we pursue few interrelated goals for students: (1) To learn specific laws of electromagnetism and their applications, (2) To develop a broad-physical-concepts view of these laws, (3) To appreciate relationship between mathematics and physical reality and to become comfortable with actually using math, (4) To strengthen generic problem-solving skills.

Our focus will be not on "training" and "dry" learning of the materials but on conceptual understanding and developing skills to apply basic principles to actual problem solving. Lectures and problem solving sessions will include examples of how to approach problems; students are expected to spend as much as possible of their own time on problems, quizzes, etc. Some of the stuff we will discuss would be more for fun and inspiration than for an in-depth study.

Students in this class will

- Be able to explain basic notions of electric charges, currents, electromagnetic fields, forces and waves, and discuss them in the context of broad physical concepts like reality of physical fields, superposition principle and conservation of charge and energy.
- Demonstrate how basic laws (Coulomb's and Gauss's in electrostatics, Biot-Savart and Ampere's in magnetostatics, Faraday's and Lenz's for time-dependent fields) can be applied to calculate electric and magnetic fields from the sources, and effects of electric and magnetic forces acting on charged particles and currents.
- Analyze simple electric circuits (batteries, resistors, capacitors, and inductors) in direct-current and quasi-steady-state regimes.
- Be able to give examples of specific electromagnetic phenomena/applications in nature and in technology that illustrate the basic laws.
- Be able to understand the meaning of Maxwell equations and their consequences for the existence and propagation of electromagnetic waves.

Course Description

This brief high-level description is intended to give a glimpse of some of the subjects we will be talking about (not necessarily in the same order and to different depths).

INTRODUCTION
Electric charges and fields; Properties of electric charges; Coulomb's law and superposition; Conductors and insulators; Magnetic fields and Lorenz force; How Maxwell equations look like.

MATHEMATICS OF VECTOR FIELDS
Vectors, their scalar and vector products; Scalar and vector fields; Flux of vector fields and line integrals; Del operator, gradient, divergence and curl; Gauss', Stokes' and Helmholtz theorems.

ELECTROSTATICS
Gauss' law and electric filed lines; Electric potential and Poisson's equation; Potential and fields of continuous charge distributions; Earnshaw's theorem (instability of equilibrium in electrostatic fields); Conductors and insulators in electric fields; Method of images; Polarization of dielectrics; Capacitance and capacitors; Electrostatic energy.

ELECTRIC CURRENT AND DC CIRCUITS
Current and current density; Ohm's law; Conductivity in metals, insulators and semiconductors; Superconductors; Electrical energy and dissipation; Combinations of resistors; Kirchoff's rules; RC circuits.

MAGNETOSTATICS
Magnetic forces on and between current elements; Biot-Savart and Ampere's laws; Magnetic fluxes and field lines; Vector potential; Solenoids; Magnetostatic energy and inductance; Magnetization and magnetic materials.

MOTION OF CHARGES IN ELECTRIC AND MAGNETIC FIELDS
Cathode ray tube (CRT); "Levitation" by electrostatic traveling waves; Mass-spectrometers and cyclotrons; Crossed electric and magnetic fields: Hall effect.

TIME-DEPENDENT FIELDS AND CURRENTS
Faraday's and Lenz's laws; Induced emf and electric fields; Generators and motors; Self-inductance and mutual inductance; Conservation of charge and displacement current; RL, LC and RLC circuits.

MAXWELL EQUATIONS AND ELECTROMAGNETIC WAVES
Maxwell equations and their plane wave solutions; Hertz's experiments; Energy and momentum of electromagnetic waves; Antennas; Spectrum of electromagnetic waves; Polarization, reflection, refraction and interference of electromagnetic waves.

Textbooks and Materials

There are many wonderful books that cover numerous aspects of electricity and magnetism and to different depths. Depending on student's personal demands and aesthetical preferences, he or she may find attractive alternative treatments, which, of course, is always encouraged. An extended set of lecture slides and other instructor-generated materials will be made available online on course eLearning pages. The content of the lectures however can be broader and deeper than posted materials.

The basic content material is covered in many general physics textbooks and students may use any editions of them. This particularly refers to:

- R.A. Serway and R.J. Beichner, **"Physics for Scientists and Engineers"**, Volume 2.
- D. Halliday, R. Resnick, J. Walker, **"Fundamentals of Physics"**, Volume 2.
- H.D. Young and R.A. Freedman, **"University Physics"**, Volume 2

The following give examples of books which utilize vector calculus in their presentation at a level that appears suitable for this course:

- R.P. Feynman, R.B. Leighton, & M. Sands, **"The Feynman Lectures on Physics"**, Vol. 2 – Read this for the Physics of it!
- D. Dugdale, **"Essentials of Electromagnetism"**.
- A. Shadowitz, **"The Electromagnetic Field".**

To better appreciate the genesis of ideas related to the concept of physical fields, an interested student may like

- A. Einstein and L. Infeld, **"Evolution of Physics"**.

Assignments, Evaluation and Grading Policy

In accordance with the course objectives, practical understanding and problem solving skills is the key to high grades. For simplest exercises, students will use the same online set of timed assignments as in PHYS2326 (10 assignments with 6-7 problems each). This homework will contribute approximately 15% to the final grade. Students are **required** to register on the online homework website (the course key provided on the eLearning pages): http://www.ilrn.com/ilrn/

The major ingredient of a regular grading procedure is the results of 3 intermediate and 1 final written exams, each contributing about 20% to the final grade. Intermediate exams are not pre-scheduled for definite dates but would occur after each block of 3 homework assignments. Intermediate exams may or may not be *take-home* exams. The **final exam** is on the UTD schedule (**December 10** at **2:00 pm**) and takes place in the classroom. The exams consist of 4-5 creative problems and are different in the spirit from homework. Here students have to show their logic and analytic work (no multiple choice problems), partial credits are given. When in the classroom, exams are open book. In all cases, a student **should be able** to explain his/her solution. The instructor reserves up to 15% of the final grade to reward students' participation in problem solving in the classroom and in extra assignments.

Course & Instructor Policies

Every attempt will be made to give students an opportunity to improve their standing. That will include the possibility of individual make-up tests at the end of the semester. Results of exams are open for individual discussions. All questions about exam grades should be addressed the same

week the grades become known. All special student needs should be reported within first two weeks of the course.

A proactive student's position in and out of the classroom is encouraged and expected, and your feedback is always welcome. Attendance of lectures is strongly advised but not required. The integrity of students' behavior matters - working in groups and using various materials is encouraged but it is the individual understanding of the subject and results that will be tested.

Communication of all grades and announcements will be through eLearning, it is the **responsibility of students** to regularly check their eLearning pages and email.

Last but not least, the instructor strongly feels that satisfaction one gets from the learning accomplishments makes "grades" a much less sensitive issue. My general position is that "I am here not to make your life harder but to help you learn". I would like to invite all students to have more fun from learning and worry less about grading. This should be especially true for this Honors class!

Off-campus Instruction and Course Activities

Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm. Additional information is available from the office of the school dean.

Student Conduct & Discipline

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year. The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391). A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

Academic Integrity

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings. Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

Email Use

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

Withdrawal from Class

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

Student Grievance Procedures

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures.* In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

Incomplete Grade Policy

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

Disability Services

The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.
The contact information for the Office of Disability Services is:
The University of Texas at Dallas, SU 22
PO Box 830688
Richardson, Texas 75083-0688
(972) 883-2098 (voice or TTY)
Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.
It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

Religious Holy Days

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated. The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

These descriptions and timelines are subject to change at the discretion of the Professor.